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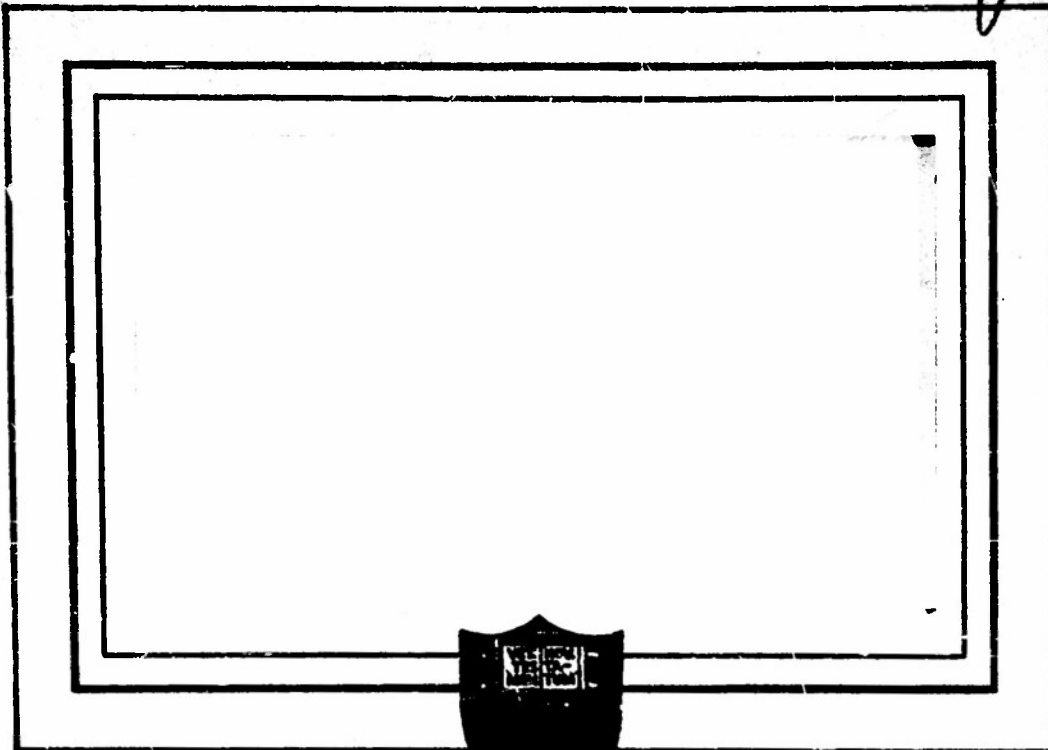
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Contract N6-ori-105, Task Order IV

Dielectric Properties and the Structure
of Matter

Charles P. Smyth, Project Leader

Report No. 32

Periodic Status Report

April 1 - June 30
1953

Department of Chemistry

Princeton University

U.S. Navy Department

Office of Naval Research

Dielectric Properties and the Structure of Matter
Periodic Status Report, April 1 - June 30, 1953

Charles P. Smyth

Mr. A Di Giacomo, after one year on the Project as an Assistant in Research and two years of collaboration with the Project program on a fellowship, has received his Ph.D. degree and taken a position with E.I. Du Pont de Nemours & Co. The results of most of his investigations of dipole moments and molecular orientation in solids will be prepared for publication during the next year.

Further alterations have been made in the apparatus for the investigation of crystalline solids at 3.2 cm. wavelength. The apparatus has been extensively recalibrated and measurements have been started. An appreciable loss has been found in the low temperature solid phase of *t*-butyl chloride, which may be due to traces of hydrogen chloride. Work has been started upon dl - camphor.

Measurements of dielectric constant and dielectric loss at 1.2 cm. wavelength have been made by Mr. R.S. Holland on solutions of 2,2-dinitropropane in heptane and nujol solutions, and on 2,2-dichloropropane in heptane solution in a continuation of the study of the dielectric properties of substituted methanes. The results of the measurements on the 2,2-dinitropropane - heptane system have been combined with refractive index ^{data} and/or obtained by Dr. G.N. Roberts at wavelengths of 6.6, 10 and 30 cm. to yield Cole and Cole plots at temperatures of 2°, 20° and 40°. The following values of the distribution constant α and critical wavelength λ_m were obtained:

2°	$\alpha = 0.01$	$\lambda_m = 0.70$	cm.
20°	$\alpha = 0.02$	$\lambda_m = 0.56$	cm.
40°	$\alpha = 0.01$	$\lambda_m = 0.49$	cm.

Complete calculations have not yet been made on the other two systems, however, the data on the 2,2-dinitropropane-nujol system seem to indicate a critical wavelength of slightly over 1.2 cm., and also a considerable atomic polarization, since the refractive index point does not agree well with the microwave points. However, this discrepancy may be due to some other effect, since the refractive index point agrees well with the microwave points when heptane is used as the solvent.

Mr. A. Tulinskie has obtained a dipole moment 0.42×10^{-18} and an atomic polarization 7.9 cc. for perfluorodiethyl ether in the vapor state, values which are consistent with those reported in the last Periodic Status Report for perfluorodimethyl ether. An apparently consistent series of measurements gave for perfluoropropylene a moment value 0.46 and an atomic polarization 14.3, which is so high that the measurements will be repeated.

Scientific Paper July 1 - June 30, 1953

"Microwave Absorption and Dielectric Relaxation in Some Long-Chain Esters," by P.L. McGeer, A.J. Curtis, G.B. Rathmann and C.P. Smyth. Presented before the American Physical Society, Denver, Col., July 1, 1952.

"Microwave Absorption and Molecular Structure in Liquids. VIII, Dielectric Relaxation in Some Long-Chain Esters," by P.L. McGeer, A.J. Curtis, G.B. Rathmann and C.P. Smyth, Journal of the American Chemical Society, 74, 3541 (1952).

"Microwave Absorption and Molecular Structure in Liquids. IX. Measurement in Organic Halides at 10 cm. Wavelength," by F.H. Branin, Jr. and C.P. Smyth. Journal of Chemical Physics, 20, 1121 (1952).

"A Calculation of the Static Dielectric Constant of Ice," by J.G. Powles, Journal of Chemical Physics, 20, 1302 (1952).

"Dielectric Relaxation in d-Camphor," by J.G. Powles, Journal of Chemical Physics, 20, 1648 (1952).

"The Dipole Moments and Molecular Structures of Cyclheptatrienone and Three Tetracyclones," by Armand Di Giacomo and Charles P. Smyth, Journal of the American Chemical Society, 74, 4411 (1952).

"The Determination of Complex Dielectric Constants of Absorptive Liquids by Microwave Interferometry," by Franklin H. Branin, Jr., Journal of Applied Physics, 23, 990 (1952).

"Dielectric Dispersion in the Microwave Region of Six Tetrasubstituted Methanes in the Solid State," by J.G. Powles, D.E. Williams and C.P. Smyth, Journal of Chemical Physics, 21, 136 (1953).

"The Dipole Moments and Structures of cis- and trans-1,2-Dichlorocyclohexane," by A. Tulinskie, A. Di Giacomo and C.P. Smyth. Accepted for publication by the Journal of the American Chemical Society.

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